INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2004/001135

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: B07C 5/36, 5/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B07C 5/36, 5/10, 5/02, 5/342

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI IPC B07C 5/36, 5/10, 5/02, 5/342 and Keywords (radial+ or coni+ or invert+ or mono+);
USPTO and Keywords

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4858771 A (HAWKINS ET AL.) 22 August 1989 See figures 1-6 and column 3 lines 12-34	1-17
X	Derwent Abstract Accession No. 94-041938/05, Class P43, SU 1787589 A (LENGD PLEKHANOV MINE) 15 January 1993	21, 23
X	Derwent Abstract Accession No. 2001-058797/07, Class P43 T05, NL 1015994-C2 (BASTIAAN POMSTRA HODN POM_TEL ELECTRONIC) 11 October 2000	21, 23
X	WO 2000/041143 A (SCAN COIN INDUSTRIES AB) 13 July 2000 See whole document	21, 23

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
8 October 2004

Date of mailing of the international search report 13 OCT 2004

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INTERNATIONAL SEARCH REPORT

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PCT/AU2004/001135

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 1993/025324 A (VALTION TEKNILLINEN TUTKIMUSKESKUS) 23 December 1993 See whole document	22, 24
X	WO 1988/001378 A (THE BRITISH PETROLEUM COMPANY P.L.C.) 25 February 1988 See whole document	22, 24

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Supplemental Box
(To be used when the space in any of Boxes I to VIII is not sufficient)

Continuation of Box No: III

The International application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept. In coming this conclusion the Intentional Searching Authority has found that there are three inventions:

1. Claims 1-20 are directed to a method and apparatus for sorting a flow of particulate material comprising the steps of passing the particles axially over a conical surface to form an annular flow; operating a detector substantially centred within the annular flow and selected to apply a sorting criterion on the particles in the said flow. It is considered that the above integers comprises a first "special technical feature".

2. Claims 21, 23 are directed to a method and apparatus for sorting a flow of particulate material, wherein an optical detector having a monochromatic light is used to apply a sorting criteria to the particle flow. It is considered that the above integers comprises a second "special technical feature".

3. Claims 22, 24 are directed to a method and apparatus for sorting a flow of particulate material wherein an detector assembly operates an array of a plurality of fluid-jet sorting means, applies a sorting criteria to the particle flow. It is considered that the above integers comprises a third "special technical feature".

Since the above-mentioned groups of claims do not share either technical features identified, a "technical relationship" between the inventions, as defined in PCT Rule 13.2 does not exist. Accordingly the International application does not relate to one invention as a single inventive concept.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2004/001135

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	4858771	AU	17525/83	AU	17526/83	BR	8304195
		BR	8304196	CA	1212357	CA	1231319
		IN	159729	IN	159730	US	4549659
		ZA	8305643	ZA	8305644	ZW	17783
		ZW	17883				
SU	1787589						
NL	1015994						
WO	0041143	SE	9900022				
WO	9325324	AU	40737/93	CA	2137461	EP	0646049
		US	5577671				
WO	8801378	AU	77562/87	BR	8707425	EP	0277170
		IN	169782	NL	8720394	SU	1809921
		US	5143224	ZA	8705558		

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX

AMENDED CLAIMS

[received by the International Bureau on 14 December 2004 (14.12.04); original claims 1-24 replaced by new claims 1-22 (4 pages).]

1. A sorting method including the steps of:

forming an at least part annular, substantially monolayer flow of particulate material by axially flowing said particulate material over a body member having a substantially conical flow surface bounded by a substantially horizontal peripheral edge and whereby said flow is directed substantially vertically from said edge under gravity;

operating a detector having an optical element located substantially centred within said annular flow downstream of said body member whereby the path length from all parts of the flow to said detector is substantially constant, said detector being selected to apply a sorting criterion on the particles in said flow; and

operating sorting means responsive to said detector to sort particles in said flow according to said criterion.

2. Sorting apparatus including:

a body member having a substantially conical surface bounded by a substantially horizontal peripheral edge;

a supply of a particulate material to said flow surface, said supply being selected whereby said particulate material axially passes said peripheral edge and is directed substantially vertically from said edge under gravity forming an at least part annular, substantially monolayer flow;

a detector having an optical element located substantially centred within said annular flow downstream of said body member whereby the path length from all parts of the flow to said detector is substantially constant, said detector being selected to apply a sorting criterion on the particles in said flow; and

sorting means responsive to said detector to sort particles in said flow according to said criterion.

3. Sorting apparatus according to Claim 2, wherein said particles are formed into an annular flow.

4. Sorting apparatus according to Claim 2, wherein said particulate flow passes the edge of the body member to enter a detection area downstream of the body member and containing the optical element.

5. Sorting apparatus according to Claim 4, wherein said particulate flow is irradiated by an actual or effectively rotating a source, and that the detector detects the intensity of the reflected or transmitted component of said radiation.

6. Sorting apparatus according to Claim 5, wherein said source is a monochromatic point-source beam which scans the particulate flow in a direction normal to the particulate flow direction.

7. Sorting apparatus according to Claim 6, wherein said reflected light is filtered to remove all other wavelengths than the required wavelength to render the detected signal monochromatic.

8. Sorting apparatus according to Claim 7, wherein said filtering is performed using one or more band pass optical filters that transmit only the required wavelength bands.

9. Sorting apparatus according to Claim 7, wherein said filtering is performed using one or more band reject optical filters that reflect only the required wavelength bands.

10. Sorting apparatus according to claim 5, wherein said detected light is polychromatic.

11. Sorting apparatus according to Claim 10, wherein said polychromatic light is resolved into a spectrum by a diffraction grating, and wherein said detector comprises a plurality of detection elements disposed to interpret said spectrum.

12. Sorting apparatus according to Claim 11, wherein said detection elements are selected from photo multipliers, CCD arrays or like photoelectric sensitive measuring devices.

13. Sorting apparatus according to any one of Claims 2 to 12, wherein said sorting means comprises one or more rejectors responsive to said detector and adapted to impinge upon a selected particle to displace said particle from said flow.

14. Sorting apparatus according to Claim 13, wherein said one or more rejectors each comprise means to generate an air blast which rejects a detected particle from the particulate flow in response to a signal generated in response to detection by said detector.

15. Sorting apparatus according to Claim 14, wherein said rejectors comprise an annular manifold containing a single row of air valves, each valve facing approximately 90° to the particulate flow, substantially parallel to the product flow and offset with a clearance gap therefrom.

16. Sorting apparatus according to Claim 14, wherein said rejectors comprise a plurality of annular manifolds each containing a single row of air valves, each valve facing approximately 90° to the particulate flow, substantially parallel to the product flow and offset with a clearance gap therefrom, and wherein said air valves are aligned between the rows in the direction of said flow, whereby aligned air valves are operated sequentially to impact a selected particle sequentially.

17. A sorting method comprising:
forming an at least part annular flow of material;

detecting by a detector radiation from the material in the at least part annular flow, the radiation from substantially all parts of the flow having travelled substantially the same distance from the annular flow to the detector; and

operating a sorting mechanism in response to the detected radiation to sort the material in the flow.

18. The method of claim 17, wherein the radiation is received by an optical element located substantially centrally with respect to the at least part annular flow, and wherein the optical element directs the radiation to the detector.

19. The sorting method according to claim 18 wherein the optical element comprises a rotatable mirror.

20. A sorting apparatus comprising:

means for forming an at least part annular flow of material;

a detector for detecting radiation from the material in the at least part annular flow after the radiation from substantially all parts of the flow has travelled substantially the same distance from the flow to the detector; and

a sorting mechanism for sorting material in the flow in response to the radiation detected by the detector.

21. A sorting apparatus according to claim 20, wherein an optical element is arranged substantially centrally with respect to the annular flow when the annular flow is created for directing radiation from the material in the annular flow to the detector.

22. The sorting apparatus according to claim 21 wherein the optical element comprises a rotating mirror.